TOPIC 09 – REDOX

9.5 – ELECTROLYTIC CELLS

IB Chemistry

T09D03

Mr. Martin Brakke

9.5 – Electrolytic Cells

- 9.5.1 Describe, using a diagram, the essential components of an electrolytic cell. (2)
- 9.5.2 State that oxidation occurs at the positive electrode (anode) and reduction occurs at the negative electrode (cathode). (1)
- 9.5.3 Describe how current is conducted in an electrolytic cell. (2)
- 9.5.4 Deduce the products of the electrolysis of a molten salt. (3)

Electrolytic Cell Diagram

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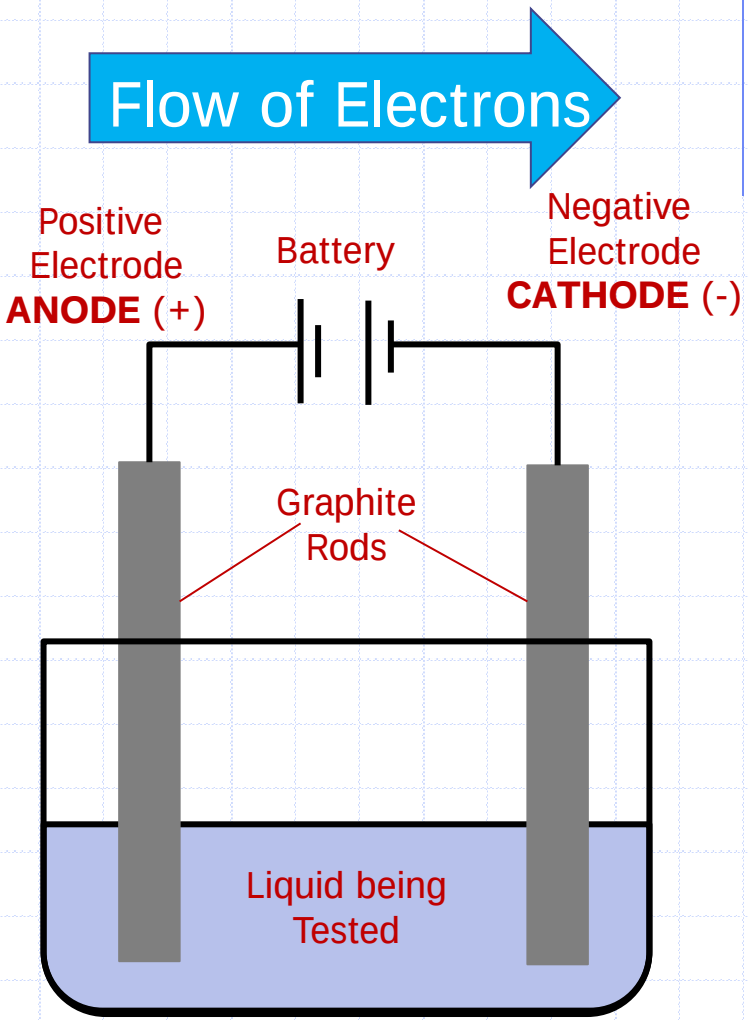
9.5.1 Describe, using a diagram, the essential components of an electrolytic cell. (2)

- An electrolytic cell is set up with a battery in order to force the movement of electrons through the solution
- Notice how the cathode and anode are different than in the Voltaic Cell
  - Cathode = (-)
  - Anode = (+)



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Electrolysis

9.5.2 State that oxidation occurs at the positive electrode (anode) and reduction occurs at the negative electrode (cathode). (1)

- A substance conducts electricity and is decomposed by the passage of electrical current is known as an **electrolyte**
- The process of decomposing such a material is known as **electrolysis**
  - We still follow the RedCat/AnOx labelling method, but just as in the conductivity tester
    - Anode = (+) = Oxidation (loss of e)
    - Cathode = (-) = Reduction (gain of e)

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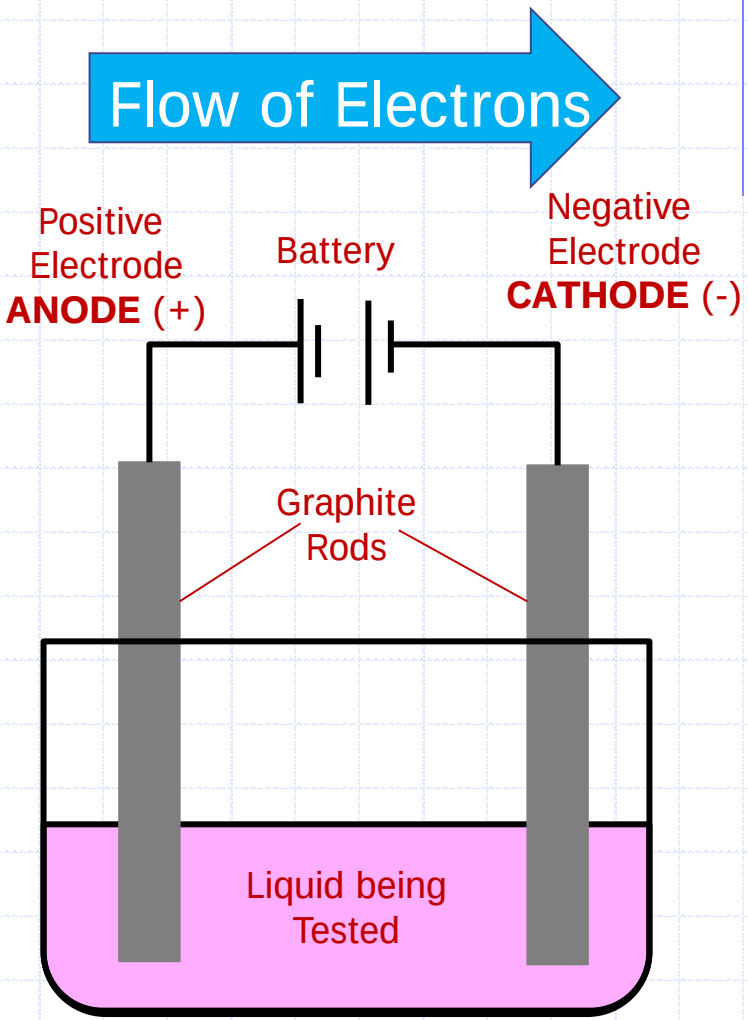
Cell Conductivity

9.5.3 Describe how current is conducted in an electrolytic cell. (2)

- In order to test to conductivity of liquids, a conductivity tester can be used
- When the current is passed through a metal, it's not effected



Conductor vs. Insulator

- A **conductor** is a substance that allows electricity to pass through it
  - Metals
  - Graphite
  - Aqueous solutions of acids, alkalis
  - Ionic compounds when aqueous or molten
- An **insulator** is a substance that does NOT allow electricity to pass through it
  - Non-metallic elements (except graphite)
  - Dry samples of covalent compounds
  - Solid samples of ionic compounds

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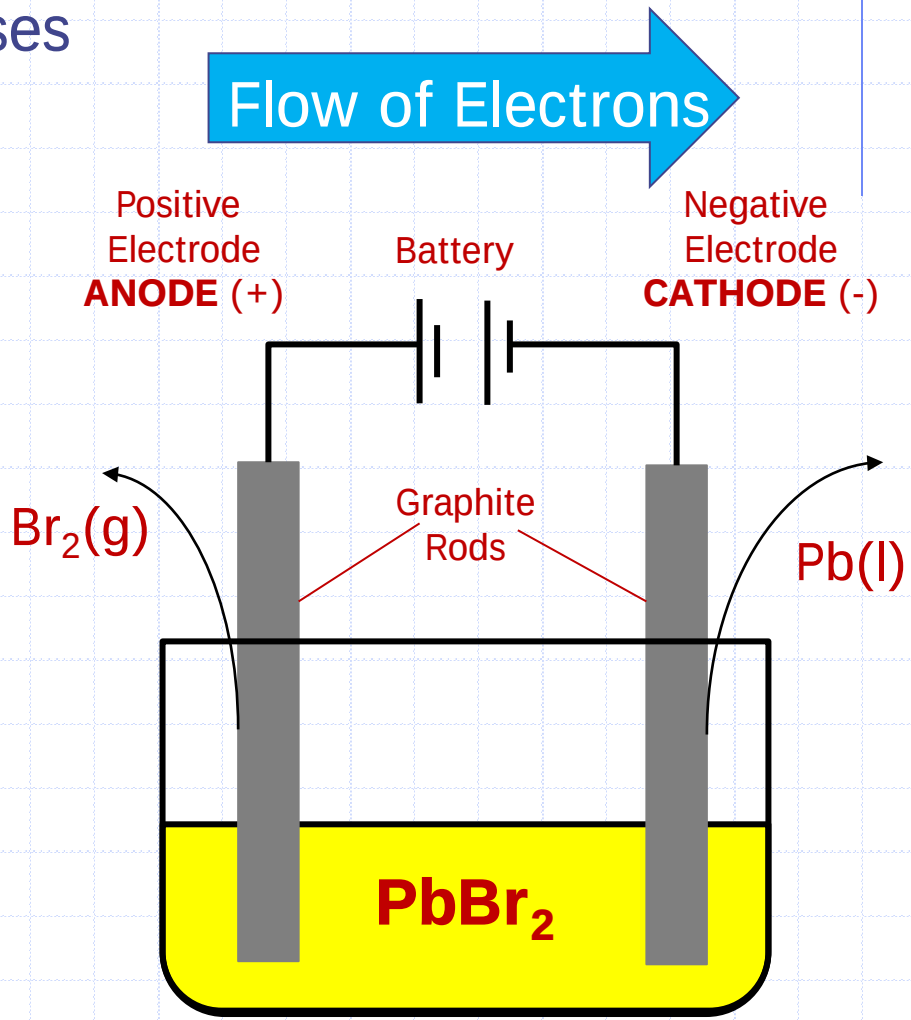
Products of Electrolysis of a Salt

9.5.4 Deduce the products of the electrolysis of a molten salt. (3)

- When an electrical current passes through an ionic substance (molten or in solution), the compound undergoes chemical decomposition
- For a solution of $PbBr_2$
- Notice the Anode is on the left
- At the ANODE:
  - $Br^{-1}(l) \rightarrow \frac{1}{2}Br_2(g) + 1e^{-1}$
- At the CATHODE:
  - $Pb^{2+}(l) + 2e^{-1} \rightarrow Pb(l)$



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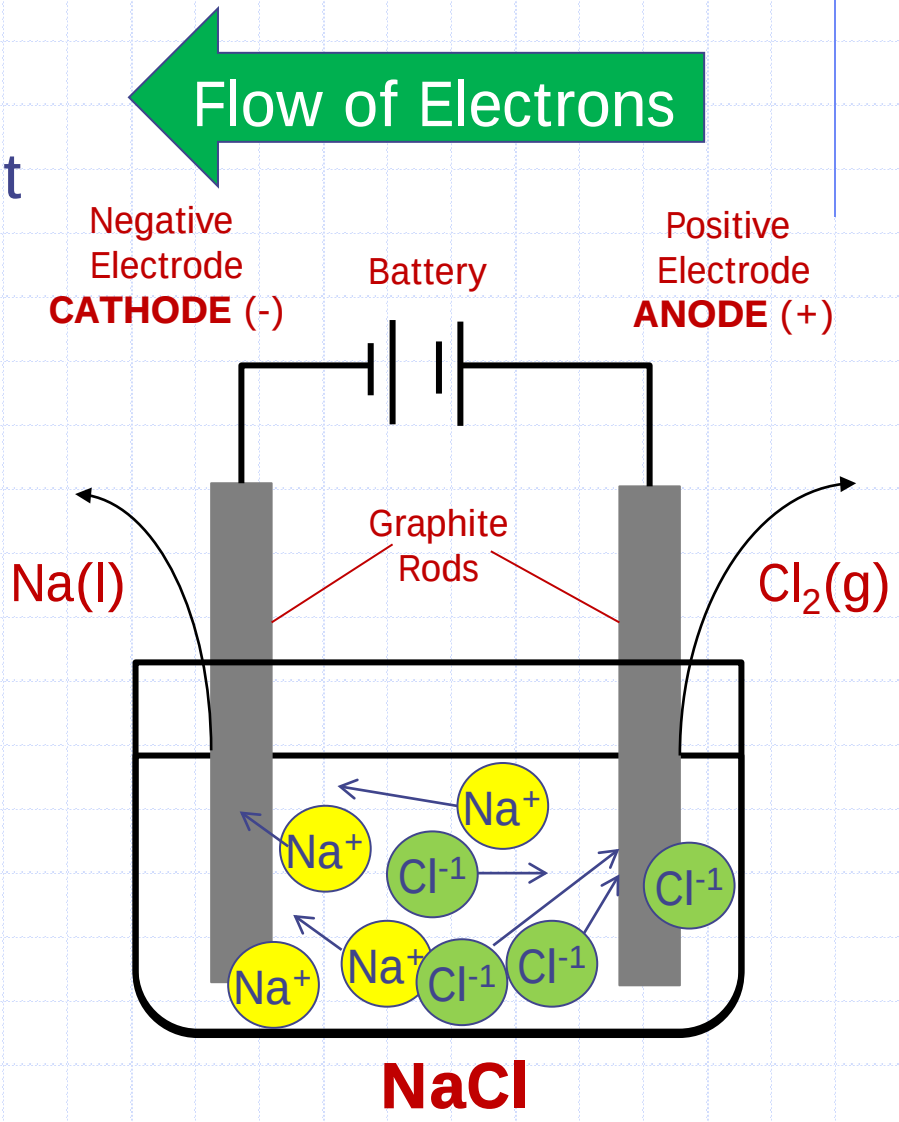
Products of Electrolysis of a Salt

9.5.4 Deduce the products of the electrolysis of a molten salt. (3)

- For a solution of NaCl
- Notice the Anode is on the right
- At the ANODE:
  - $Cl^{-1}(l) \rightarrow \frac{1}{2}Cl_2(g) + 1e^{-1}$
- At the CATHODE:
  - $Na^{+}(l) + e^{-1} \rightarrow Na(l)$
- Metals for cations and migrate toward the cathode
- Non-metals for anions and migrate toward the anode



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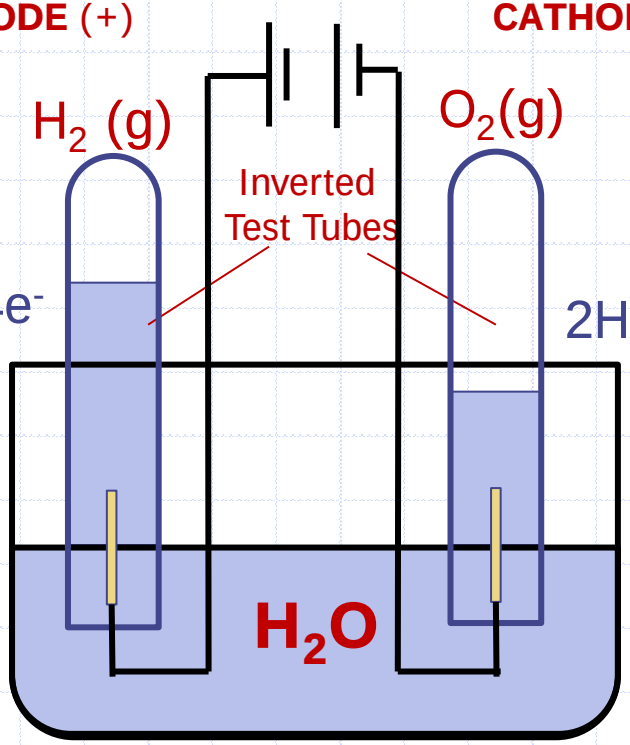
Electrolysis of Water

Flow of Electrons

Positive Electrode
ANODE (+)

Battery

Negative Electrode
CATHODE (-)



Oxidation

$2O^{-2} \rightarrow O_2(g) + 4e^{-1}$

$H_2O(l) \rightarrow O_2(g) + 4H^+ + 4e^-$

Reduction

$2H^+ + 2e^{-1} \rightarrow H_2(g)$

$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-$

2:1 Ratio
$H_2 : O_2$

**Must be acidified, H_2SO_4 or other

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Electroplating

The metal you want to use to plate onto another metal is made the anode

Metal to be plated is made the cathode